

CLAIMS:

1. A mixing valve comprising
a valve body including a hot fluid inlet for receiving a flow of hot
fluid, a cold fluid inlet for receiving a flow of cold fluid, a mixed fluid outlet, and a
5 cavity between the mixed fluid outlet and the inlets,
a first seat in the cavity,
a second seat in the cavity,
a thermostat assembly movable in response to changes in mixed fluid
temperature, and
10 a valve member in the cavity movable in response to movement of the
thermostatic assembly between a first position permitting flow of at least one of the
hot and cold fluids and a second position restricting a majority of flow of hot fluid
through the valve member.
2. The mixing valve of claim 1, wherein the first seat is upstream
15 of the second seat and the valve member in the second position engages the second
seat and restricts the flow of hot and cold fluid.
3. The mixing valve of claim 1, wherein the first seat is upstream
of the second seat and the valve member in the second position engages the second
seat and restricts the flow of hot fluid only.
- 20 4. The mixing valve of claim 1, wherein the valve member
includes a weep opening to permit restricted flow of only the hot fluid when the valve
member is in the second position.
5. The mixing valve of claim 1, wherein the valve member
includes a weep opening to permit restricted flow of the hot and cold fluid when the
25 valve member is in the second position.
6. The mixing valve of claim 1, wherein the thermostat assembly
includes a thermostat coupled to the valve member to move the valve member in
response to changing temperature of mixed fluid, wherein upon failure of the
thermostat, the valve member is biased to the second position.
- 30 7. The mixing valve of claim 1, wherein the valve member
includes a cylindrical portion having an upstream end and a downstream end, the
upstream end engaging the first seat when the valve member is in the first position.

8. The mixing valve of claim 7, wherein the valve member further includes a disc coupled to the downstream end of the cylindrical portion, the disc engaging the second seat when the valve member is in the second position.

9. The mixing valve of claim 8, wherein the disc is formed to
5 include a weep opening to permit restricted flow of hot fluid when the valve member is in the second position.

10. The mixing valve of claim 7, further comprising a liner in the cavity, the liner providing a hot liner inlet to receive a flow of hot fluid from the hot fluid inlet, wherein the liner includes a floor and the hot liner inlet is a slot formed in
10 a side of the liner adjacent the floor.

11. The mixing valve of claim 10, wherein the cylindrical portion cooperates with the slot to cover the slot when the valve member is in the first position.

12. The mixing valve of claim 1, further comprising a liner in the
15 cavity, the liner providing a hot liner inlet to receive a flow of hot fluid from the hot fluid inlet, wherein the liner includes a floor and the hot liner inlet is a bore formed in the floor.

13. The mixing valve of claim 12, wherein the valve member is a poppet, and the bore is bordered by a wall providing the first seat, the poppet
20 engaging the first seat when the valve member is in the first position.

14. The mixing valve of claim 12, wherein the valve member is a poppet, and the poppet engages an inwardly facing wall of the bore when the valve member is in the first position.

15. The mixing valve of claim 14, wherein the poppet engages the
25 inwardly facing wall of the bore when the valve member is in the second position.

16. The mixing valve of claim 15, wherein the poppet includes a first o-ring to engage the inwardly facing wall of the bore when the valve member is in the first position, and a second o-ring to engage the inwardly facing wall of the bore when the valve member is in the second position.

30 17. The mixing valve of claim 1, wherein the valve member moves along a central axis, and the second seat is an annular flange extending radially inwardly toward the axis.

18. The mixing valve of claim 1, wherein the valve member is a poppet that engages the first seat when the valve member is in the first position.

19. The mixing valve of claim 1, wherein the valve member is a poppet, the first seat borders a bore through which the hot fluid flows into the cavity,
5 and the poppet engages an inwardly facing wall of the bore when the valve member is in the first position.

20. The mixing valve of claim 19, wherein the poppet engages the inwardly facing wall of the bore when the valve member is in the second position.

21. The mixing valve of claim 1, wherein the valve member
10 includes a plurality of spaced apart mixing fins projecting generally radially outwardly.

22. A mixing valve comprising:
a valve body including a cold fluid inlet configured to be coupled to a source of cold fluid, a hot fluid inlet configured to be coupled to a source of hot fluid,
15 a mixed fluid outlet, a cold fluid passageway between the cold fluid inlet and the mixed fluid outlet, a hot fluid passageway between the hot fluid inlet and the mixed fluid outlet, and a cavity between the inlets and the outlet,

a liner disposed in the cavity, the liner including an upstream region having a hot liner inlet in communication with the hot fluid inlet, a downstream
20 region between the upstream region and the mixed fluid outlet, the downstream region including a downstream valve seat and a cold liner inlet in communication with the cold fluid inlet, and

a valve member disposed at least partially in the liner and movable between a first position to block the flow of fluid through the hot liner inlet and a
25 second position engaging the downstream valve seat to restrict flow of fluid from the hot and cold liner inlets, the valve member including a downstream section formed to include a weep opening to permit restricted flow of at least the relatively hotter fluid therethrough when the valve member is in the second position.

23. The mixing valve of claim 22, wherein the liner includes an upstream valve seat, and the valve member engages the upstream valve seat when the
30 valve member is in the first position.

24. The mixing valve of claim 22, further comprising a thermostat coupled to the valve member to move the valve member in response to changing

temperature of mixed fluid, wherein upon failure of the thermostat, the valve member moves to the second position.

25. The mixing valve of claim 22, wherein the valve member includes a cylindrical portion having an upstream end and a downstream end, the upstream end engaging the first seat.

26. The mixing valve of claim 25, wherein the valve member further includes a disc coupled to the downstream end of the cylindrical portion, the disc engaging the downstream valve seat when the valve member is in the second position.

27. The mixing valve of claim 25, wherein the liner includes a floor and the hot liner inlet is a slot formed in a side of the liner adjacent the floor.

28. The mixing valve of claim 22, wherein the liner includes a floor and the hot liner inlet is a bore formed in the floor.

29. The mixing valve of claim 22, wherein the downstream valve seat is an annular flange coupled to and extending radially inwardly from the liner.

30. A mixing valve comprising a valve body including a hot fluid inlet for receiving a flow of hot fluid, a cold fluid inlet for receiving a flow of cold fluid, a mixed fluid outlet, a cavity between the mixed fluid outlet and the inlets, a first seat in the cavity, and a second seat in the cavity,

and a valve member movable in the cavity between a first position permitting flow of at least one of the hot and cold fluids and a second position restricting a majority of flow of hot fluid through the valve member, the valve member including a plurality of spaced-apart mixing fins configured to encourage mixing by creating turbulence in fluid flowing past the mixing fins.

31. The mixing valve of claim 30, further comprising a thermostat assembly movable in response to changes in the temperature of the mixed fluid, the valve member being operatively coupled to the thermostat assembly to move in response to movement of the thermostat assembly.

32. The mixing valve of claim 31, wherein the thermostat assembly includes a thermostat including a nested bellows.

33. The mixing valve of claim 30, further comprising a liner in the cavity having a hot liner inlet coupled to the hot fluid inlet and a cold liner inlet

coupled to the cold fluid inlet, wherein the hot liner inlet is a bore formed in a floor of the liner.

34. The mixing valve of claim 33, wherein the valve member includes a disc having an upstream-facing surface for engaging the first seat when the valve member is in the first position and an opposite downstream-facing surface for engaging the second seat when the valve member is in the second position.

35. The mixing valve of claim 30, further comprising a liner in the cavity having a hot liner inlet coupled to the hot fluid inlet and a cold liner inlet coupled to the cold fluid inlet, wherein the hot liner inlet is a slot formed in a side of the liner.

36. The mixing valve of claim 30, further comprising a liner in the cavity having a hot liner inlet coupled to the hot fluid inlet and a cold liner inlet coupled to the cold fluid inlet, wherein the liner includes the first and second seats, and the second seat is between the first seat and the cold liner inlet.

37. The mixing valve of claim 30, further comprising a liner in the cavity having a hot liner inlet coupled to the hot fluid inlet and a cold liner inlet coupled to the cold fluid inlet, wherein the liner includes the first and second seats, and the cold liner inlet is between the second seat and the first seat.

38. The mixing valve of claim 30, further comprising a thermostat coupled to the valve member to move the valve member in response to changes in temperature of the mixed fluid, wherein the valve member engages the second seat to inhibit flow of hot fluid, and the mixing valve is formed to include a weep port to permit restricted flow of hot fluid to the thermostat when the valve member engages the second seat.

39. A mixing valve for mixing a first relatively hotter fluid and a second relatively colder fluid, the mixing valve comprising
a valve body including a cold fluid inlet, a hot fluid inlet, a mixed fluid outlet, a cavity wherein fluid from the cold and hot fluid inlets flow together, the cavity having an upstream region and a downstream region, the downstream region being between the upstream region and the mixed fluid outlet, a first seat disposed in the upstream region, and a second seat disposed in the downstream region;

a thermostat assembly including a thermostat responsive to the temperature of the mixed fluid, the assembly movable between an extended position

when the thermostat senses a relatively higher temperature and a retracted position when the thermostat senses a relatively lower temperature; and

a valve member in the valve body movable in response to movement of the thermostat assembly between a first position engaging the first seat when the thermostat senses a first mixed fluid temperature, and a second position engaging the second seat, in the first position the valve member blocking the hot fluid inlet, the valve member moving to the second position in response to failure of the thermostat, and the valve member moving to a third position between the first and second seats when a second mixed fluid temperature lower than the first mixed fluid temperature is sensed by the thermostat, wherein the valve member blocks the cold inlet.

40. The mixing valve of claim 39, wherein the valve member includes an upstream region and a downstream region, the downstream region engaging the second seat when the valve is in the second position, the downstream region formed to include a weep opening to permit restricted flow of fluid past the second seat when the valve member is in the second position.

41. The mixing valve of claim 39, wherein the valve member moves along an axis and includes a body and a plurality of spaced apart fins coupled to the body and extending radially outwardly from the axis, the fins each including a surface non-parallel to the axis.

42. The mixing valve of claim 41, wherein the surface is substantially perpendicular to the axis.

43. The mixing valve of claim 41, wherein the surface further extends upstream along the axis.

44. The mixing valve of claim 41, wherein each fin includes a radially outwardly facing front, a first side extending from the front to the body, and an opposite second side extending from the front to the body, the first and second sides each having an axially upstream edge, the surface extending between the upstream edges of the first and second sides, the upstream edge of the first side being axially upstream relative to the upstream edge of the second side so that the surface is slanted.

45. The mixing valve of claim 39, wherein the valve member includes a cylindrical portion to engage the first seat and a disc coupled to the cylindrical portion to engage the second seat.

46. A mixing valve comprising
a valve body providing a first fluid inlet, a second fluid inlet, a mixed fluid outlet, and a cavity defined by at least one internal wall, the cavity being in communication with the inlets and the outlet, and
- 5 a valve member movable along a central axis in the cavity between a position restricting flow from at least one of the fluid inlets and a position permitting flow through both of the inlets, the valve member including a central region and a plurality of spaced apart mixing fins each extending from the central region and including a surface that is non-parallel to the axis to facilitate mixing of the first and
- 10 second fluids.

47. The mixing valve of claim 46, wherein each fin includes a generally radially outwardly facing front, a left side and an opposite right side each extending between the front and the valve member, the surface extending between a bottom edge of each of the left and right sides, the bottom edge of one of the left and
- 15 the right sides being axially upstream of the bottom edge of the other side.

48. The mixing valve of claim 46, wherein the surface of each mixing fin is perpendicular to the axis.

49. The mixing valve of claim 46, wherein the surface of each mixing fin faces radially inwardly and axially upstream.

- 20 50. A mixing valve comprising
a valve body providing a first fluid inlet, a second fluid inlet, a mixed fluid outlet, and a cavity having a longitudinal axis, the cavity defined by at least one internal wall, and the cavity being in communication with the inlets and the outlet,
a first valve seat extending from the at least one internal wall,
- 25 a second valve seat extending from the at least one internal wall, and
a piston in the cavity and movable along the axis, the piston including a piston bore extending longitudinally therethrough and having a first piston end, a second piston end, a middle region between the ends, an engagement surface at the first piston end bordering the piston bore and engaging the first seat to block flow of
- 30 the first fluid through the piston bore, a failure shutoff surface at the second piston end movable to engage the second valve seat, the first fluid entering the piston bore between the first valve seat and the engagement surface, the piston formed to include

a slot therein positioned axially closer to the engagement surface than to the failure shutoff surface to facilitate mixing of the first and second fluids.

51. The mixing valve of claim 50, further comprising a liner including the first and second valve seats.

5 52. The mixing valve of claim 50, wherein the piston includes a plurality of spaced apart surfaces non-parallel to the axis and arranged to at least partially face the direction of flow of fluid through the piston bore to encourage turbulent flow through the piston.

53. The mixing valve of claim 52, wherein the plurality of surfaces
10 is perpendicular to the axis through the cavity.

54. The mixing valve of claim 52, wherein at least a portion of at least one of the plurality of surfaces is sloped, having a radially extending component and an axially extending component.

55. A piston for use in a fluid mixing valve, the piston comprising:
15 a main body region and
a plurality of spaced apart fins extending from the main body region, at least a portion of the fins configured to lie non-parallel to the direction of flow of at least one fluid through the valve.

56. The piston of claim 55, wherein each fin includes a surface
20 generally perpendicular to the axis.

57. The valve member of claim 55, wherein the only connection between each of the plurality of fins is the main body region.

58. The valve member of claim 55, wherein an axis extends longitudinally through the piston, each of the plurality of fins includes a surface non-
25 parallel to the axis, a front region, a left side and an opposite right side, each side extending between the front region and the main body region, the surface extending between a bottom edge of each of the left and right sides, the bottom edge of one of the left and the right sides being axially upstream of the bottom edge of the other side.

59. The valve member of claim 58, wherein each of the plurality of
30 fins includes a radially outwardly facing front surface, and the only connection between each of the plurality of structures is the main body region.